Modeling the Infrared Emission from Planetary Debris Disks

Aigen Li[1], J.I. Lunine[2], and G.J. Bendo[3]

(Email: agli@lpl.arizona.edu)

[1]Theoretical Astrophysics Program, University of Arizona, Tucson, Arizona
[2]Lunar and Planetary Laboratory, University of Arizona, Tucson, Arizona
[3]Steward Observatory, University of Arizona, Tucson, Arizona

Dust disks around young stars, depending on their age, are the source material or the remnants of newly-formed planets. The physical, chemical, and dynamical properties of circumstellar disks and their constituent grains are crucial in understanding the formation and evolution processes of planetary systems. In this talk we will present results from our recent efforts in modeling the infrared (IR) emission from protoplanetary dust disks in terms of a model consisting of highly porous cometary-type dust. In this model, the dust composition and morphology are reasonably well constrained from first-principle considerations. The dust spatial distribution is inferred from the optical/near-IR images of scattered starlight or constrained by the mid-IR and/or the submillimeter images of dust thermal emission. With reasonable adjustments of the size distribution power-index, we will show that the porous dust model with a vacuum volume fraction of $\sim 90\%$ is successful in reproducing the near-IR to submillimeter spectral energy distributions and the mid-IR spectral features of amorphous and/or crystalline silicate dust and polycyclic aromatic hydrocarbon molecules of six archetypal dust disks: HD 141569A, HR 4796A, β Pictoris, ϵ Eridani, Fomalhaut, and Vega. Finally, the potential impacts of Spitzer on our understanding of the structure and chemical properties of dust disks and their possible connection to exoplanets will also be discussed.